SCHULTZ - HANFORD AREA TRANSMISSION-LINE PROJECT

ADDENDUM TO APPENDIX F:

IMPACTS OF EMF ON AQUATIC ECOSYSTEMS AND SPECIES OF SPECIAL CONCERN

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1.0 Impacts of EMF on aquatic ecosystems and species of special concern

The proposed 500-kV Schultz-Hanford transmission line will cross the Columbia River in parallel to several other transmission lines. As a result, certain ecological concerns are evaluated regarding the potential impact of EMF associated with the proposed transmission line on the aquatic ecosystems and the aquatic species in the creeks. Species of special concern are Pacific salmon (*Oncorhynchus spp.*), particularly the chinook salmon (*O. tschawytscha*) and the steelhead (*O. mykiss*). (Personal Communication; Doug Corkran, Parsons Brinckerhoff, December 31, 2001). These species spend their adult lives in estuarine or oceanic environments and are well known for their annual spawning runs into freshwater, returning to the home streams and rivers where they were spawned and spent the first few months of their lives (Groot and Margolis, 1998). Pacific salmon are an important part of the history, ecology, and economy of the Pacific Northwest region.

1.1 Potential Exposure to EMF

The proposed 500-kV transmission line crossing over the Columbia River will be a source of magnetic field, but not electric field exposure, for fish in close vicinity to the line. (The water shields the fish from electric fields.) Since the level of EMF decreases with distance from the source, maximum magnetic-field exposures of fish will occur when they are directly under the lines , when spawning on Vernita Bar or when traveling down or up the river during their life cycle. This exposure scenario is evaluated for EMF levels based on the proposed transmission line configuration for current and future use (Bracken, 2001). The minimum clearance over the river will be greater than the minimum clearance over land, leading to exposures in the river well below the maximum of 244 mG for the proposed line at 1 m height above the earth.

2.0 Likely Biological Effects of EMF

2.1 Biological Organisms

More than one hundred studies of the effects of EMF on wildlife and domestic animals have been conducted during the past thirty years. These studies have examined basic life history aspects including survival, growth and reproduction. To date, there is little or no evidence that mammals, birds or fish exhibit any harmful effects when exposed to EMF of frequencies close to or at power frequencies (50-60 Hz), even for a prolonged period of time (NRC, 1997a). Additionally, prolonged exposure is not a critical issue for the species of concern, the salmon, because they are migratory by nature and will only be exposed to EMF associated with the proposed transmission line during the relatively short time they take to swim past or spawn under the line.

The scientific literature does not provide evidence of adverse effects of EMF exposure to living organisms at the levels associated with this project. An additional question is whether EMF exposure can affect salmon's ability to navigate during their spawning run. The Pacific salmon have been thought to navigate by several mechanisms: detecting and orienting to the earth's magnetic field, using a celestial compass (i.e., based on the position of the sun in the

sky), and using their innate ability to imprint on their home stream by odor (Groot and Margolis, 1998, Quinn et al, 1981).

Generally, scientific studies have reported that, along with other cues or biological mechanisms, certain species of birds, bees, and fish may have magnetite in certain organs in their bodies, and use magnetite crystals as an aid in navigation (Bullock, 1977; Wiltschko and Wiltschko 1991, Kirschvink, 1993, Walker et al. 1988). Crystals of magnetite have been found in Pacific salmon (Mann et al, 1998; Walker et al, 1998). These magnetite crystals are believed to serve as a compass that orients to the earth's magnetic field. However, other studies have not found magnetite in sockeye salmon (*Oncorhynchus nerka*) fry (Quinn et al, 1981). While salmon can apparently detect the geomagnetic field, their behavior is governed by multiple stimuli as demonstrated by the ineffectiveness of magnetic field stimuli in the daytime (Quinn et al, 1982) and the inability of strong magnetic fields from permanent magnets attached to sockeye salmon to alter their migration behavior (Ueda et al, 1998).

It should be noted that the earth's magnetic field is static (0 Hz), in contrast to the oscillating magnetic field created by the AC (alternating current) transmission lines crossing the Columbia River. Static magnetic fields have fixed polarity, i.e. the earth's magnetic north and south poles. The electrical current that generates the magnetic field in transmission lines constantly alternates its direction, thus, the term "alternating current" (AC). AC transmission lines produce magnetic fields that do not have fixed polarity.

No studies have been conducted to date that specifically examine the effects of AC magnetic fields on the salmon's ability to orient to the earth's magnetic field. Studies on the response of other organisms that also use magnetite crystals as one means of navigation can, however, provide useful insight regarding salmon. Kirschvink, 1993 reports studies of the effects of AC magnetic fields on honeybees, which use magnetite crystals to navigate. In this study, the honeybees only oriented to an AC magnetic field when it was one million times greater in intensity than the DC field needed to elicit the same orientation response. This difference in intensity indicates that the AC magnetic field is less influential than the DC magnetic field in the navigation of honeybees and potentially other organisms that orient to the earth's magnetic field using magnetite crystals (Kirschvink, 1993). The level of AC magnetic fields estimated for the proposed transmission line are well below the levels reported in that study.

2.2 Ecological Systems

Recently, scientists have published the results of long-term monitoring studies designed to determine ecological impacts of extremely-low-frequency (ELF) electric and magnetic fields produced by a United States Navy communication system. Power line fields are also in the ELF range. Specifically, over a period of 13 years, academic researchers in Wisconsin conducted 11 separate experiments examining the impact of ELF EMFs on ecosystems (e.g., wetlands, streams, aquatic ecosystems) and specific organisms (e.g., slime mold, birds, small vertebrates, litter decomposers and microflora, upland flora, pollinating insects, soil arthropods, earthworms, and soil amebas). The fish community examined in this study showed no significant differences in species diversity, biomass or condition when compared

to the control site. The results of the other studies also demonstrated no convincing evidence for effects of EMF on any of the organisms or ecosystems they examined (NRC, 1997b).

3.0 Conclusion

The scientific literature does not support the conclusion that the EMF associated with the proposed transmission line will have an adverse impact on the survival, growth, and reproduction of organisms in the ecosystem. There are no data on the effects of AC EMF on salmon navigation, but based on a study with honeybees, it appears that organisms that use magnetite crystals to orient to the earth's magnetic field would be affected only when the field levels are very much greater than the levels expected from the transmission line. Given this evidence and the salmon's ability to navigate using multiple sensory cues, the proposed transmission line crossing the Columbia River is unlikely to have an adverse impact on these species of concern and the aquatic ecosystems of these creeks. No effects on water quality and no ecological impacts of magnetic fields are expected.

4.0 References

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